

# MANUAL

## VBA-2E-KE4-ENC-S AS-Interface Speed Monitor



With regard to the supply of products, the current issue of the following document is applicable: The General Terms of Delivery for Products and Services of the Electrical Industry, published by the Central Association of the Electrical Industry (Zentralverband Elektrotechnik und Elektroindustrie (ZVEI) e.V.) in its most recent version as well as the supplementary clause: "Expanded reservation of proprietorship"

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### ***Conformity Statement***

AS-i Speed Monitors have been developed and produced in accordance with the applicable european standards and directives. The conformity statement according to the EC EMC-, low voltage, and -machinery directive can be sent to by request.

Additional information can be found in the Pepperl+Fuchs GmbH basic catalogue or in the online catalogue in internet.

Subject to technical modifications.

## 1. Symbol Catalog



### **Information!**

*This symbol indicates important information.*



### **Attention!**

*This symbol warns of a potential failure. Non-compliance may lead to interruptions of the device, the connected peripheral systems, or plant, potentially leading to total malfunctioning.*



### **Warning!**

*This symbol warns of an imminent danger. Non-compliance may lead to personal injuries that could be fatal or result in material damages and destruction.*

### 1.1 Abbreviations

<b>AS-i</b>	AS-interface (actuator sensor interface)
<b>I/O</b>	Input/output
<b>EMC</b>	Electromagnetic compliance
<b>PELV</b>	Protective extra-low voltage
<b>PFD</b>	Probability of failure on demand
<b>SaW</b>	Safety at Work, safety technic

## 2. General Remarks

Please read this chapter carefully before working with the documentation and the "AS-i Speed Monitor".

### 2.1 Product information

This user manual is valid for the following Pepperl+Fuchs GmbH devices:

<b>AS-i Speed Monitor</b>	<b>VBA-2E-KE4-ENC-S</b>
---------------------------	-------------------------

### 2.2 Function of this manual

This manual instructs for the safe assembly, electrical installation, addressing, start-up as well as for the operation and for the maintenance of the Speed Monitor.

This manual does **not** provide instructions for operating machines, on which this module is built in. Please view the appropriate machine manual for corresponding information.



#### **Information!**

*Additional information concerning the technical data as well as the parameterization of the Speed Monitor can be found in data sheet VBA-2E-KE4-ENC-S that can be located at [www.pepperl-fuchs.com](http://www.pepperl-fuchs.com).*

### 2.3 Target group

This manual is intended for designers, developers and operators of systems that will be safeguarded by one or more AS-i Speed Monitors. The manual is also targeted to people integrating AS-i Speed Monitors into machinery, performing the initial start-up, or maintaining them.

### 3. Safety

This chapter contains user safety information.



#### **Warning!**

*Please read this chapter carefully before using the Speed Monitor in combination with other machine safeguarding components on protected machinery.*

#### 3.1 Experienced staff

The Speed Monitor must only be installed, operated, and maintained by qualified staff.

Qualified is a person who

- has a suitable technical education
- has been instructed in operating the machinery and has been informed about the valid safety guidelines by the machinery operator
- has access to the user manual.

#### 3.2 Application area of the device

The AS-i Speed Monitor monitors the speeds of maximum two axes and sends a safety signal over the AS-i bus when the speeds fall below a preset threshold value.

##### 3.2.1 Safety category

- SIL 3 according to EN 62 061
- PLe Cat. 4 according to EN 13 849.

#### 3.3 Correct use

The AS-i Speed Monitor must only be used as defined in chap. <Application area of the device>. The AS-i Speed Monitor must only be used on the system, at which it was installed in accordance with this manual by adept personnel.



#### **Information!**

*If used in a way differing from this description or if the device has been changed in any way – even during installation – any warranty claims with respect to Pepperl+Fuchs GmbH are invalid.*

##### 3.3.1 Disposal



#### **Information!**

*Electronic waste is hazardous waste. Please comply with all local ordinances when disposing this product!*

*The device does not contain batteries that need to be removed before disposing it.*



## 4. Product Description

This chapter is intended to inform the reader about the special characteristics of the AS-i Speed Monitor. It describes the design and the functionality of the devices.



### **Warning!**

*This chapter must be read before installation and operation of the device in conjunction with other safety components on protected machinery.*

### 4.1 Technical data

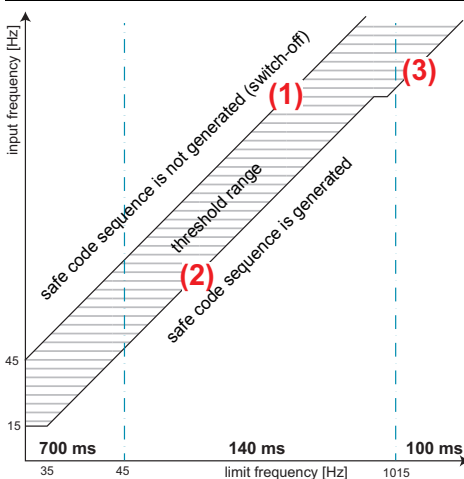
Connection	4-fold COMBICON clamp and 2 AMP Mini-IO plug connections
AS-i profile	safe input slaves: S-0.B.E., ID1=F diagnostic slaves: S-7.A.5., ID1=7 (default)
AS-i voltage	18-31,6 V
Max. AS-i current consumption	150 mA
AUX voltage	18-30 V
Max. AUX current consumption	200 mA
Voltage of insulation AS-i/AUX	500 V
Inputs	2x encoder
Parameterisation range for the speed limit	25 Hz-200 kHz
Supply voltage	out of AS-i and 24 V external
Displays	
LED 1 green (ASI)	AS-i voltage present
LED 2 red (FLT)	offline
LED 3 green (AUX)	24 V DC AUX present
LED 4 yellow (CONF)	OFF = normal mode
LED 5 yellow (ST1)	state encoder 1 (ENC 1)
LED 6 yellow (F1)	safety, low frequency or zero-speed axis 1
LED 7 yellow (F2)	safety, low frequency or zero-speed axis 2
LED 8 yellow (ST2)	state encoder 2 (ENC 2)
Applied standards	EN IEC 62 061 SIL 3 EN 954-1 cat. 4 EN 13 849-1:2006/PLe
Housing	Phoenix-ME-MAX housing
Storage temperature	0°C ... +55 °C
Operating temperature	-25°C ... +85 °C
Tolerable loading referring to humidity	according to EN 61 131-2
Protection class DIN 60 529	housing IP20
Dimensions (L / W / H in mm)	99 / 22,5 / 114

## 4.2 Safety relevant data

Identification data	value	standard
Safety category	4	EN 954-1 EN ISO 13849-1: 2008
Performance Level (PL)	E	
Safety Integrity Level (SIL)	3	EN 62061
Usage time (TM) [year]	20	EN ISO 13849-1: 2008
Max. power-on time [month]	12	EN 62061
PFH <sub>D</sub> (Probability of a dangerous failure per hour)	$2,77 \times 10^{-9}$	IEC 61508, EN 62061

### Max. system response time [ms] as a function of frequency limit

$1015 \text{ Hz} < f_{\text{limit}}$	<b>100 ms</b>
$45 \text{ Hz} < f_{\text{limit}} < 1015 \text{ Hz}$	<b>140 ms</b>
$f_{\text{limit}} < 45 \text{ Hz}$	<b>700 ms</b>



#### Frequency limit for 0-sequence

(1)  $f_{\text{in}} = (f_{\text{limit}} + 20\text{Hz}) \cdot 100.5\%$

#### Frequency limit for safety code sequence

$35 \text{ Hz} < f_{\text{limit}} < 900 \text{ Hz}$

(2)  $f_{\text{in}} = (f_{\text{limit}} - 20\text{Hz}) \cdot 99.5\%$

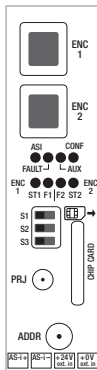
$980 \text{ Hz} < f_{\text{limit}}$

(3)  $f_{\text{in}} = (f_{\text{limit}} - 100\text{Hz}) \cdot 99.5\%$

Tab. 4-1.

The diagram shows the function of the highest input frequencies at which the code sequence is reliably generated (lower curve) and the function of the lowest input frequencies at which the code sequence is reliably not generated (upper curve) as a function of the parameterized frequency limit.

### 4.3 Front view and connections



<b>ENC 1, ENC 2</b>
encoder
<b>ADDR</b>
addressing port
<b>Chip Card</b>
chip card //
<b>S 1, S 2, S 3</b>
function selector switch
<b>PRJ</b>
configuration push button
<b>ASI+, ASI-</b>
AS-i connection
<b>AUX<sup>+</sup>ext.in: AUX<sup>-</sup>ext.in</b>
voltage supply for the input

#### 4.3.1 Operating elements

The operating elements are located on the top side beneath the transparent folding cover.

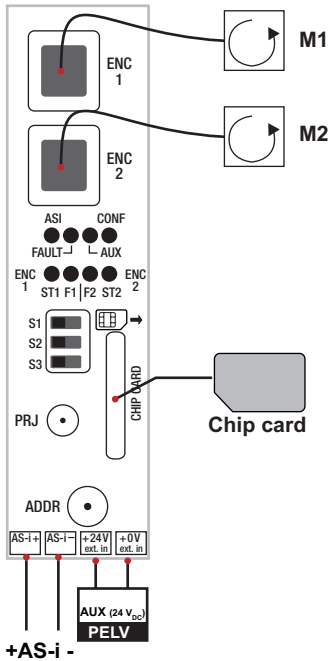
The addressing socket and projecting buttons are accessible through holes even when the cover is closed.

To open the cover, for example to remove the chip card or set the switches, both encoders must be unplugged.

### 4.4 Electrical connection

The Speed Monitor has a 4x Combicon terminal and 2 AMP Mini-IO connectors. The Speed Monitor is powered from AS-i and an external 24 V.

The pin configuration of the Mini-IO plugs depends on the sensor type and power supply type. The terminal functions must be matched to the sensor used as well as the application (power from the Speed Monitor or from the drive).



















#### Attention!


The AS-I power supply for the AS-I components must have isolation per IEC 60 742 and be able to handle momentary power interruptions of up to 20 ms. The power supply for the 24 V supply must also have isolation per IEC 60 742 and be able to handle momentary power interruptions of up to 20 ms. The maximum output voltage of the power supply must also be less than 42 V in case of a fault.





The correct safety function of the device must be verified once installed within the protected machinery!

## 4.5 LEDs

LEDs	Status	Signal // Description
ASI green		AS-i supply power not OK
		periphery fault or address '0'
		AS-i supply power OK
FAULT red		on-line
		periphery fault
		off-line
AUX green		24 V <sub>DC</sub> AUX missing
		24 V <sub>DC</sub> AUX present
CONF yellow		normal operation
	 2 x 1Hz	chip card is written
ST1, ST2 yellow		the corresponding encoder <i>not</i> connected
		error message
		the corresponding encoder connected
F1, F2 yellow		no safe, low frequency or stop axis 1/2
		error message
		safe, low frequency or stop axis 1 / 2

 LED on

 LED flashing

 LED off

Tab. 4-2.

### 4.5.1 Error messages via LED

ST1	F1	F2	ST2	error
		—	—	error encoder 1
—	—			error encoder 2
				chip card and device containing unequal, non-empty data
				chip card is faulty
				fatal error

Tab. 4-3.



#### Information!

For devices with the delivered default settings (yet no projected configuration), the two LEDs **Fault** and **ASI** flashing alternately.

### 4.5.2 Function selection switches



<b>S1 - Off (RUN)</b>
normal operating state
<b>S1 - On (Clear)</b>
factory setting mode
<b>S2, S3 (NC)</b>
reserved



#### Information!

Function selection switches S2 and S3 currently have no function. In the future these will be used for selecting various options (e.g. encoder or resolver).

#### Factory setting mode

The function selection switch S1 can be used to reset the device to its default settings.

- ☐ Disconnect AS-i voltage.
  - ☐ Set the function selection switch S1 to the On position (Clear).
  - ☐ Finally connect AS-i voltage again.
- ⇒ A run light on LEDs ST1, ST2, F1 and F2 appears for 5 s.

- During this time push and hold the projecting button as long as the running light stops flashing.
- ⇒ The device is reset to its factory default settings.
- Set the function selection switch S1 to the Off position (Run).
- ⇒ The device is in the normal operating state.

#### 4.6 Projecting button

The Projecting button can be used to store currently present frequencies. The stored values can then be loaded via software.

While values are being stored the **CONF** LED flashes.

The **CONF** LED goes out again as soon as the stored values have been loaded. Values stored using the Projecting button are deleted at **Power-on**.



##### **Information!**

*The exact sequence of the parameterization is described in Sec. <Parameter Setting>.*

#### 4.7 Chip card

The chip card is used for storing the device parameters, speeding up the time required to replace defective units. Exchanging the chip card moves all parameters from the old unit to the new one.

##### **Unit replacement: Chip card "not blank" in a non-configured unit (unit in factory default state)**

If a non-blank chip card is plugged into a configured unit, the data are copied to the unit.

##### **Blank chip card in a configured unit**

If a blank chip card is plugged into a configured unit, the data are copied to the chip card.

##### **Data in the unit and the chip card are not the same**

If the chip card and the unit are not blank and contain different data, there will be an error message (see Sec. <LEDs>).



##### **Warning!**

*Verify the safety functions after replacing the unit!*

#### 4.8 Sensors

In the present design only encoders may be connected.



##### **Information!**

*Please note additional information in Sec. <Encoder requirements>.*

#### 4.9 AS-i data

A safety signal is output (code sequence generated) when the frequency falls below the set threshold.

	Diagslv DO2	$f < 25\text{Hz}$	$25\text{Hz} < f < f_{\max}$	$f_{\max} < f$	$f > f_{\text{limit}}$ (or other failure)
AS-i SaW sequence safe speed	0	SaW Code	SaW Code	0- sequence	0-sequence
	1	0- sequence	0-sequence		
AS-i SaW sequence stop	0	SaW Code			
	1	0- sequence			

Tab. 4-4.



#### Information!

$f_{\max}$  is the set upper limit for the safety frequency range,  $f_{\text{limit}}$  is the frequency limit of the unit (250 kHz).



#### Information!

0-sequence can be enforced in the diagnostic slave via the DO2.

The Speed Monitor includes 2 to 5 Slaves:

- **A diagnostic slave with profile S-7.A.5 (A/B Slave) for conventional setting, e.g. using an AS-i Adresse.**

The diagnostic slave provides 2 analog input data, the current frequency of the 2 axes, scaled in 10 Hz increments (0 ... 20,000 corresponds to 0 ... 200,000 Hz). For diagnostics all safety signals are also available in the diagnostic slave.

- **1 ... 4 AS-i SaW Slaves settable via software using the diagnostic slave.** Setting options for all safety signals to be represented as a common message on just one SaW input slave, or any desired combination of safety signals affect up to four SaW input slaves (four SaW input slaves if each safety signal needs to be reported separately).

#### 4.9.1 Examples:

- Safety speed axis 1 = e.g. Address 17
- Safety speed axis 2 = e.g. Address 17

Stopped is also the safety state.

#### Stopped is required separately:

- Safety stopped axis 1 = e.g. Address 18
- Safety stopped axis 2 = e.g. Address 18

Code sequence for safe speed and safe stop.



## 5. Maintenance

### 5.1 Controlling safe shutdowns

The plant safety engineer is responsible for verifying that the AS-i Speed Monitor works correctly as part of the safety system.

At least once a year it is necessary to verify the safe shutdown by initiating associated safety-related sensors or switches:



**Attention!**

*Press each safety-related AS-i slave and watch the reaction of the output circuits of the AS-i Safety Monitor.*



**Attention!**

*Check the maximum activated time and the total operating time. These values depend on the PFD value chosen for the total failure probability. Please refer to the information in chap. <Safety relevant data>.*

*After reaching the projected maximum operating time (three, six, or twelve months) the entire safety system must be checked for proper operation.*

*After reaching the projected total usage time (20 years) the device must be checked by the manufacturer concerning its proper operation.*

## 6. Parameter Setting

Parameter setting is software assisted. To make it possible to also set parameters using an AS-i Master with integrated Safety Monitor, two different methods are supported:

- The Projecting button is used to teach frequencies which can then be confirmed on the display of an AS-i Master with integrated Safety Monitor. In this case the set parameters must be documented via PC or manually.
- Similar to the AS-i Safety Monitor using the PC interface and reading back the data per text. Communication between the Speed Monitor and the PC is over AS-i.

### 6.1 Parameters

Each channel uses the following parameters

- AS-i Address
- Channel activated, channel not activated
- Detection of Safety Stop active, detection of Safety Stop not active
- Maximum allowed safe speed.

### 6.2 Setting parameters using AS-i Master with integrated Safety Monitor

1. The Speed Monitor is connected to the AS-i circuit.
2. The non-safety slave is addressed.
3. The connected axes are brought to safe speed. If multiple Speed Monitors are connected, the Projecting button is actuated. The **CONF** LED flashes.
4. From the menu select "Speed Monitor." If multiple Speed Monitors are connected, you can select which device (AS-i address of the non-safety slave) is parameterized.
5. This menu is displayed

```
SPEED MONITOR
PASSWORD
xxxx
OK          ESC
```

A 4-digit number can be entered. The factory default setting is password 0000. The password must be set to a different value in order to run the device.

6. In the next menu item the addresses of the safety-limited speed (SLS) are assigned

```
ADDRESSES SLS
CH1 23
CH2 24
OK          ESC
```

First the previously set values are shown. These can be overwritten.

If the same address is entered for multiple channels, the results of these channels are overlaid. Only if all frequencies for these channels are within the range of the safety-limited speed is an SaW code sequence sent. This also makes it possible for example to combine Channel 1 and 2 into a single address.

Channels for which 0 is entered as an address are deactivated.

7. In the next menu item the addresses of the safety stop are assigned.

```
ADDRESSES STOP
CH1 23
CH2 24
OK ESC
```

First the previously set values are shown. These can be overwritten.

If the same address is entered for multiple channels, the results of these channels are overlaid. Only if all frequencies for these channels are within the range of the safety-limited speed is an SaW code sequence sent. This also makes it possible for example to combine Channel 1 and 2 into a single address.

Channels for which 0 is entered as an address are deactivated.

8. After clicking on OK the following menu appears  
Here the taught frequencies + 10% tolerance are shown.

```
FREQUENCY
CH1 23433
CH2 24355
OK ESC
```

9. The displayed values can be overwritten. To deactivate a channel, set the frequency to 0 or set no AS-i address.  
10. After clicking on OK the data are shown again.

```
ADDR FREQUENCY
CH1-12-23433
CH2-13-24355
OK ESC
```

11. After clicking on OK the following menu appears

```
ADDR STOP
CH1-14
CH2-15
OK ESC
```

12. After clicking on OK the following menu appears

```
RELEASE WITH PASSWORD
WORD
XXXX
OK ESC
```

Here you must enter the password. If a new password is entered, it is applied immediately.

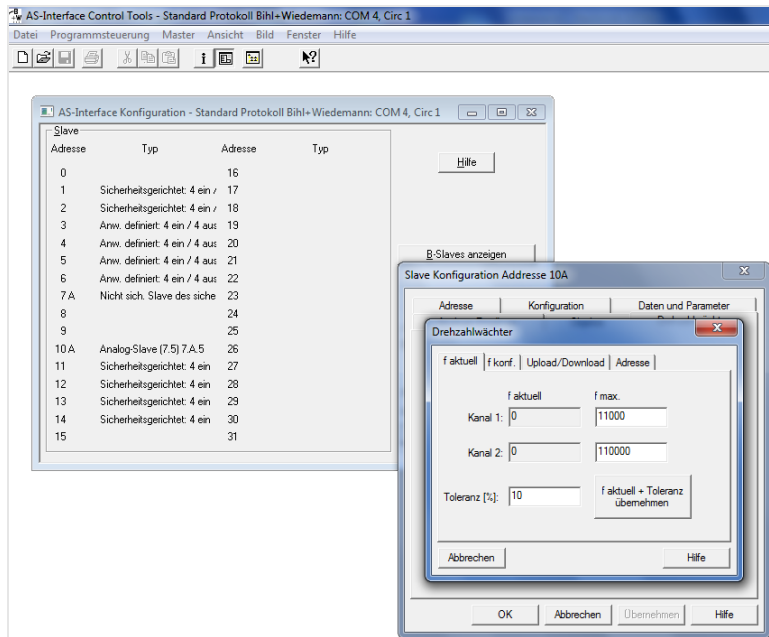
13. This releases the parameter set.  
14. The release procedure must be documented with date, name of the person releasing and the set parameters, and stored with the equipment documentation.  
15. Before first starting up check the function of the Speed Monitor.

### **6.3 Procedure for setting parameters using PC software**

1. The Speed Monitor is connected to the AS-i circuit.
2. The non-safety slave is addressed.
3. The connected axes are brought to safe speed. If multiple Speed Monitors are connected, the Projecting button is actuated. The CONF LED flashes.
4. From the PC software the AS-i Master is used to select the diagnostic slave of the Speed Monitor.
5. Parameters are set using the PC software (see description in Sec <PC Software>). Either the value stored with the Projecting button can be used or another entered.
6. If the ID should be changed, this can be done.
7. The project planer uses the software to release the data with his name and his ID. Name, date and ID are also stored by both CPUs with a CRC check.
8. The data are written over AS-i to the Speed Monitor and there stored with CRC check. So the data are valid for the Speed Monitor.
9. The PC software reads out the parameters as plain text over AS-i and displays them in a separate window as a release protocol. There is no conversion, rather the data come out of the Speed Monitor as plain text.
10. The release protocol is printed out by the releasing person and filed as a part of the plant documentation.
11. Before first starting up check the function of the Speed Monitor.

## 6.4 PC Software

The following illustrations show the setting possibilities in schematic form.

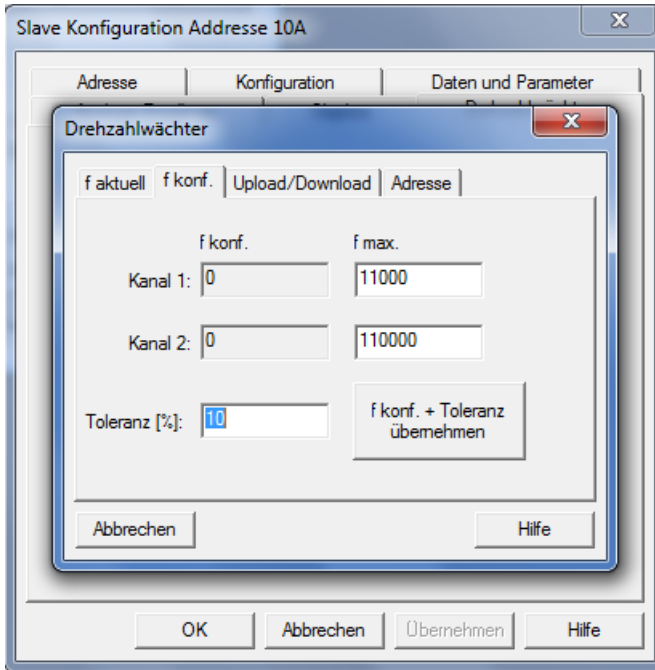


In this menu the frequencies set using the Projecting button are displayed and can be uploaded raised by the tolerance factor as  $f_{\max}$ . Alternately the value  $f_{\max}$  can also be directly entered.



### **Information!**

*Uploading also activates.*

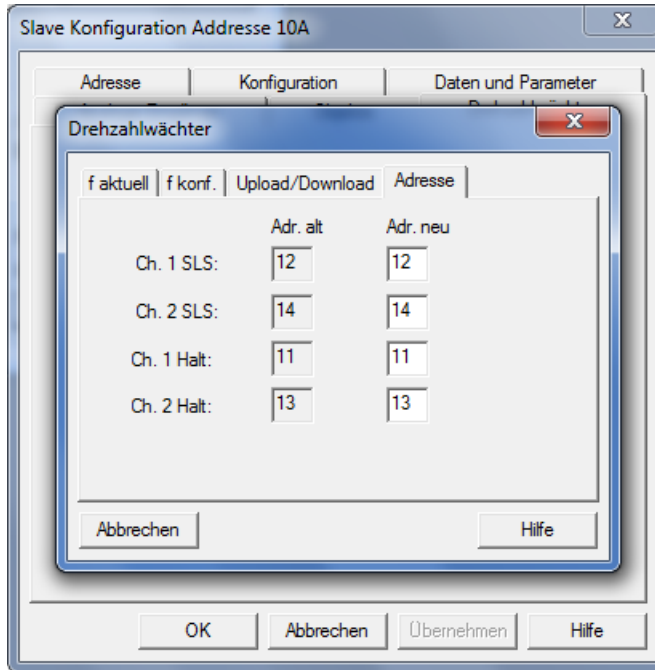


In this menu the frequencies set using the Projecting button are displayed and can be uploaded raised by the tolerance factor as  $f_{\max}$ . Alternately the value  $f_{\max}$  can also be directly entered.

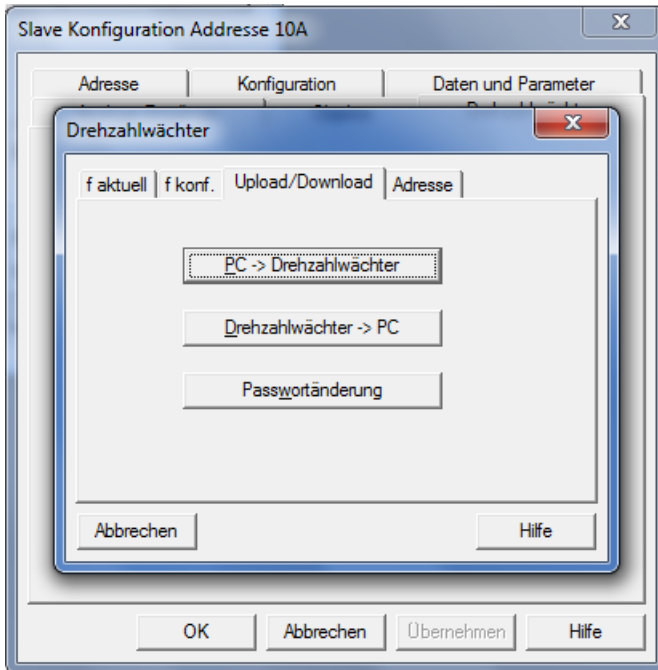


**Information!**

*Uploading also activates.*



If the same address is entered for multiple channels, the results of these channels are overlaid. Only if all frequencies for these channels are within the range of the safety-limited speed is an SaW code sequence sent. This also makes it possible for example to combine Channel 1 and 2 into a single address.



In this menu the upload and download procedure is controlled. For downloading (Speed Monitor ' PC) the protocol is read from the Speed Monitor, for uploading (PC ' Speed Monitor) the previously set values are written to the Speed Monitor.



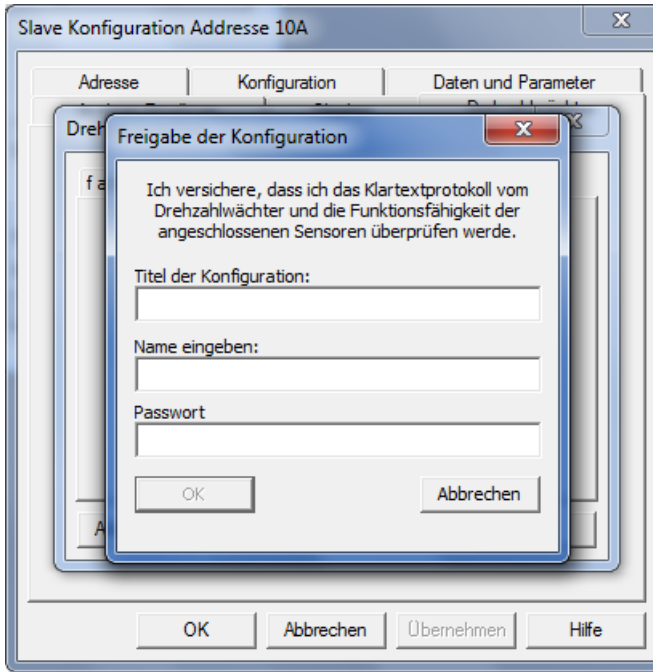
After uploading the protocol listing appears:

```

0000 ***** 0
0001 PARAMETER SAFE SPEED MONITOR 1
0002 IDENT: Spiral-Faedler oben 2
0003 ***** 3
0004 DEVICE SECTION 4
0005 ***** 5
0006 Monitor Version: 0.2 6
0007 Config Structure: 1.0 7
0008 Config Tool: act32 v4.6.26 8
0009 Download Time: 2010-08-03 14:17 9
0010 Validated: 2010-08-03 14:17 0
0011 by: Bernhard Wiedemann 1
0012 Security Code: BAEA, Count: 2 2
0013 ***** 3
0014 CHANNEL SECTION 4
0015 ***** 5
0016 Channel 1, f1: Active, Addr: 11 6
0017 f1max: 1000 Hz 7
0018 ----- 8
0019 Channel 2, f1: Active, Addr: 12 9
0020 f1max: 21500 Hz 0
0021 ----- 1
0022 Channel 1, f2: Active, Addr: 10 2
0023 f2max: 25 Hz 3
0024 ----- 4
0025 Channel 2, f2: Inactive 5
0026 f2max: ----- Hz 6
0027 ***** 7
0028 Validated: 2010-08-03 14:17 8
0029 by: Bernhard Wiedemann 9
0030 Security Code: BAEA, Count: 2 0
0031 ***** 1
0032 END OF CONFIGURATION 2
0033 ***** 3

```

Then the following dialog box is shown:



## 6.5 Releasing the configuration



### **Information!**

*By releasing the configuration you as the safety representative confirm proper construction and maintaining of all safety-relevant regulations and standards for the application.*



### **Information!**

*Release of the configuration, like some other safety-relevant commands, is password protected.*

## 6.6 Configuration documentation

### Configuration protocol

The configuration protocol is used for safety-relevant documentation of the application. It contains all the information about the configuration of the Speed Monitor.

The preliminary configuration protocol is used for checking the configuration of the Speed Monitor and of the safety-relevant AS-i application by the safety representative.

The final configuration protocol is used for documenting the configuration of the Speed Monitor and of the safety-relevant AS-i application by the safety representative. It is an important component of the safety-relevant documentation for your application and must be stored together with it.



#### **Information!**

*The configuration protocol is always written uniformly in English.*



#### **Information!**

*For additional information, please refer to the separate documentation for the "ASI-MON 3G2" software.*

### Example of a configuration protocol

```

0000 ***** 0
0001 PARAMETER SAFE SPEED MONITOR 1
0002 IDENT: Spiral-Faedler oben 2
0003 ***** 3
0004 DEVICE SECTION 4
0005 ***** 5
0006 Monitor Version: 0.2 6
0007 Config Structure: 1.0 7
0008 Config Tool: act32 v4.6.26 8
0009 Download Time: 2010-08-03 14:17 9
0010 Validated: 2010-08-03 14:17 0
0011 by: Bernhard Wiedemann 1
0012 Security Code: BAEA, Count: 2 2
0013 ***** 3
0014 CHANNEL SECTION 4
0015 ***** 5
0016 Channel 1, f1: Active, Addr: 11 6
0017 flmax: 1000 Hz 7
0018 ----- 8
0019 Channel 2, f1: Active, Addr: 12 9
0020 flmax: 21500 Hz 0
0021 ----- 1
0022 Channel 1, f2: Active, Addr: 10 2
0023 f2max: 25 Hz 3
0024 ----- 4
0025 Channel 2, f2: Inactive 5
0026 f2max: ----- Hz 6
0027 ***** 7
0028 Validated: 2010-08-03 14:17 8
0029 by: Bernhard Wiedemann 9
0030 Security Code: BAEA, Count: 2 0
0031 ***** 1
0032 END OF CONFIGURATION 2
0033 ***** 3

```

"VALIDATED..." (line 10-12):

Mark for final configuration protocol with release information

- data and time
- name
- code

The protocol in the example consists of 34 lines, 40+1 (linebreak) characters per line = 1394 characters.

The final configuration protocol is used for safety-relevant documentation of the application by the responsible safety representative.

Print out this protocol and keep it together with the other safety-relevant documentation for your application.

## **7. Safety Requirements**

### **7.1 Encoder requirements**

- Incremental encoder.
- 1Vpp sine/cosine permissible (also from Hiperface or Endat 01 or Endat 02).
- For error exclusion the signal and symmetrical signal must be connected.
- The encoders are powered either externally or from the Speed Monitor. The Speed Monitor provides 5 V (max. 100 mA). The power source (internal/ external) is determined by the connection wiring. If the encoder is powered externally, the connected voltages must not exceed 5.4 V, and if there is more than 5.4 V the current provided on each line may not exceed 44 mA.

### **7.2 Rotary position transducer requirements**

- Rotary position transducers must have the appropriate performance level for the application.
- Observe the instructions provided by the transducer manufacturer.

# FACTORY AUTOMATION – SENSING YOUR NEEDS



## Worldwide Headquarters

Pepperl+Fuchs GmbH  
68307 Mannheim · Germany  
Tel. +49 621 776-0  
E-mail: [info@de.pepperl-fuchs.com](mailto:info@de.pepperl-fuchs.com)

## USA Headquarters

Pepperl+Fuchs Inc.  
Twinsburg, Ohio 44087 · USA  
Tel. +1 330 4253555  
E-mail: [sales@us.pepperl-fuchs.com](mailto:sales@us.pepperl-fuchs.com)

## Asia Pacific Headquarters

Pepperl+Fuchs Pte Ltd.  
Company Registration No. 199003130E  
Singapore 139942  
Tel. +65 67799091  
E-mail: [sales@sg.pepperl-fuchs.com](mailto:sales@sg.pepperl-fuchs.com)

**[www.pepperl-fuchs.com](http://www.pepperl-fuchs.com)**

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